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**Information Pathology and the Army Tactical
Command and Control System (ATCCS): Is
ATCCS a Cure?**

**A Monograph
by
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Air Defense Artillery**



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MONOGRAPH APPROVAL

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Army Tactical Command and Control
System (ATCCS): Is ATCCS a Cure ?

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ABSTRACT

Automation has become an ever more pervasive way of doing business, not only in the civilian sector, but in the military as well. The Army's command and control structure has, and will continue to be, a major recipient of much of this automation. Some view automation as being only more "electronic gadgetry" which will not be any more capable of meeting information needs than previous command and control systems. The purpose of this paper is to determine whether or not the Army Tactical Command and Control System (ATCCS) (a highly automated system) will meet the information needs of a heavy brigade commander. Special emphasis is placed on whether or not the ATCCS will increase or decrease the information overload a brigade commander can experience in planning for and executing battles and engagements.

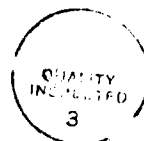
The paper will review the information needs of a brigade commander and what qualities that information ought to possess (i.e. relevant, timely, accurate, in a useable form, and in the right amount). These qualities of information will be used as criteria to evaluate command and control theory, doctrine, the current command and control environment and finally, the ATCCS itself.

An examination of command and control theory and doctrine will reveal that theory and doctrine both highlight the requirement for an effective command and control system able to produce information with the above stated characteristics. The current command and control environment will be shown as often lacking in supplying the brigade commander the quality information he needs for sound decision-making. Although the ATCCS is not yet fielded, it is designed to furnish the commander the type and quality information he needs. There are, however, some important cautions that must be dealt with if the ATCCS is to support the commander on the future AirLand battlefield.

Foremost among these cautions is the need for effective information management, identification of Commander's Critical Information Requirements (CCIR), and attention by higher level staffs on their use of the ATCCS. If these warnings are not adhered to, the potential for information overload at the brigade level is enormous.

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I. Introduction

The next battlefield will be demanding of our leaders, soldiers, and equipment. The requirement for an effective command and control system that helps alleviate the uncertainty of war is critical to the heavy brigade commander. It is crucial that this command and control requirement be met, if he hopes to fight and win on the battlefield of the future.

A review of literature that contrasts past battlefields with current or future battlefields yields common terminology. The more frequently used terms are, increased complexity, lethality, and intensity. Additional descriptions refer to the greater scope, speed, and fluidity that will characterize the modern battlefield. FM 100-5 states that, "[t]he high-and mid-intensity battlefields are likely to be chaotic, intense, and highly destructive. They will probably extend across a wider space of air, land, and sea than previously experienced."

While the above descriptions accurately describe evolution of the modern battlefield, there are, however, some timeless characteristics that have not changed: terrain, weather, the friction of war, and the human dimension are a few examples. One of the most important of these is the human dimension. "The human dimension of war will be decisive in the campaigns and

battles of the future just as it has been in the past."²

A subset of the human dimension of war is the brigade commander and the role he plays on the battlefield. The future battlefield will present him with new challenges. Conditions of combat on the future battlefield will be "unforgiving of errors and will demand great skill, imagination, and flexibility."³

The greater scope and fluidity of the future battlefield will demand that commanders at all levels receive greater amounts of pertinent information in order to make logical, more rapid decisions.

"Information is the medium of the command and control process -- a process that has the products of decisions and directives."⁴ "Information is the raw material of decisions."⁵ The command and control system that the brigade commander uses must provide him information with certain qualities.

Information must be relevant. The information must pertain to the situation with which the commander is concerned. Information about future enemy intentions 72 hours out may be interesting; however, it may not be relevant to the current situation faced by the commander.

Information must be accurate. It must portray the situation in factual terms. It must hold up under

repeated tests and not be a momentary phenomenon that cannot be relied upon for significant problem solving.⁶ Acting or basing decisions on inaccurate information could result in catastrophe.

Information must be timely. It must be the latest possible information available. Clearly, information that has been overcome by events will be of no use to the commander. The closer information is to real-time, the better it is for the commander.

Information must be in a useable form. A commander may have neither the time nor the tolerance to sift through reams of paper or scroll through screens of data before finding the desired information. The information must be displayed in such a way so he can assimilate the information and make a decision quickly.

Information must be in the right amount. There must be enough information to make a decision with some degree of confidence.⁷ On the other hand, the commander must not be so overwhelmed with information that his decision-making ability is paralyzed. The quantity of information must be limited enough to allow the brigade commander to make sound decisions within his human capabilities and yet it must include a minimum number of critical information requirements to support a decision.⁸

These characteristics of information (i.e. relevancy, accuracy, timeliness, useability, and information in the right amount) constitute quality information and will be the criteria used throughout this study. These criteria will be used to analyze and evaluate theory, doctrine, the current command and control environment, and the future command and control system.

The command and control system that the Army is proposing to use to meet the heavy brigade commander's information requirements is the Army Tactical Command and Control System (ATCCS). This study will review the ATCCS to assess its ability to meet the brigade commander's information needs on the modern battlefield. The specific question to be answered is whether or not the ATCCS will increase or decrease the information overload a brigade commander can experience in planning for and executing battles and engagements.

The first step in answering this question is to define some key terms as well as review some of the theory and doctrine behind command and control, to include the medium (information) of a command and control system. This will help us gain some understanding of command and control, command and control systems, the relationship between the two, as well as the role of information.

Next we will focus on an investigation of the current command and control environment, with specific attention on the information aspect of command and control. We will review the ATCCS and its components to understand how it works and relates to the theory and doctrine of command and control. How the ATCCS impacts on a brigade commander's decision-making ability and whether or not it provides him quality information will be evaluated and analyzed.

Finally, we will compare the current command and control system with the ATCCS. This comparison will establish whether or not the ATCCS will provide the brigade commander information meeting our criteria. We will pay special attention to whether the ATCCS will increase or decrease his information overload.

II. Definition and Theory of Command and Control

Command and control is defined by JCS Pub 1 as:

The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.⁹

A command and control system is defined by JCS Pub 1 as:

The facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing and controlling operations of assigned forces pursuant to missions assigned.¹⁰

Information is defined by AR 525-1 as:

Data that have been processed by automated or manual means and in a format that can be used by a decision-maker to satisfy a knowledge requirement.¹¹

It must be noted that while command and control are defined as though they were one term, they are not. There is a very important distinction between the two. General John W. Foss in a recent Military Review article, "Command," states that "Control is inversely proportional to command. A good commander is like a good horseman; he maintains a strong grip and at the same time keeps a loose rein."¹² In short, the commander must balance command and control to optimize his combat power and accomplish the unit's mission.

Without a functional command and control system, the brigade commander may be doomed to failure. The command and control system's ability to provide quality information is the key to successful planning, directing, coordinating, and controlling processes.

With a basic understanding of key terms related to command and control, a look at command and control theory will shed additional light on the subject area. Past and present theorists, specifically, Sun Tzu, Carl Von Clausewitz, S.L.A. Marshall, and Martin Van Creveld, offer some valuable material in understanding command and control and the role of information in the decision-making process.

Sun Tzu does not address command and control in the modern sense of the term. He does, however, offer one of the most important insights regarding the significance of information in the conduct of battle.

If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.¹³

This famous dictum speaks volumes regarding the importance of an effective command and control system that will supply accurate and relevant information, not only about the enemy, but also about your own situation (i.e., personnel status, training levels, equipment readiness, etc.). Sun Tzu clearly equated information with success on the battlefield.

Carl Von Clausewitz, like Sun Tzu, does not address command and control in the modern sense of the term. In fact, "given the perils of friction, Clausewitz expressed little faith in any sort of universal control system."¹⁴ However, he very clearly addresses the relationship between the commander and information.

Since all information and assumptions are open to doubt, and with chance at work everywhere, the commander continually finds that things are not as he expected. This is bound to influence his plans, or at least the assumptions underlying them. If this influence is sufficiently powerful to cause a change in his plans, he must usually work out new ones; but for these the necessary information may not be immediately available. During an operation decisions have usually to be made at once: there may be no time to review the situation or even to think it through. Usually, of course, new

information and reevaluation are not enough to make us give up our intentions: they only call them in question. We know more, but this makes us more, not less uncertain. The latest reports do not all arrive at once: they merely trickle in. They continually impinge on our decisions, and our mind must be permanently armed, so to speak, to deal with them.¹⁵

Clearly, Clausewitz recognized the importance of information to the commander and the role information plays in the "friction of war."¹⁶ He would not dismiss the importance of a commander's "coup d'oeil"¹⁷ in seeing through information problems; however, he would probably attest to the value of a command and control system that could provide correct quantities of information in a timely and accurate fashion.

In his book, Men Against Fire, S.L.A. Marshall spends a substantial amount of time dealing with the role of information in battle. He highlights the dichotomy between the actual direction of information flow on the battlefield and the direction it should flow, by portraying the flow of men, materiel, orders, and instructions as ever toward the front, while information is ever toward the rear.¹⁸ He, like Clausewitz and Sun Tzu, recognized the importance of quality information for the successful commander.

It is a truth beyond argument that full and accurate information becomes most vital at the point of impact, for unless it is correctly applied there, the wisest plans of the ablest general will likely fail. But the organization of tactical information during combat runs directly counter to this principle, almost as if it followed an unwritten law-

the lower the rank of the commander, the less he is entitled to know of his own affairs.¹⁹

Whether or not Martin Van Creveld can be considered a theorist may be arguable; however, he offers some keen insights regarding command and control and the role of information on the battlefield. He views the history of command and control systems as a quest for certainty through the acquisition of information.

The history of command [command being defined by Van Creveld as consisting of command, control, and communications] can thus be understood in terms of a race between the demand for information and the ability of command systems to meet it.²⁰

He recognizes that certainty is the product of time as well as of information and that in order to save the former you must do with less of the latter.²¹ He also makes an interesting judgment, which we will address later, on the role of technology in today's command and control process.

Taken as a whole, present-day military forces, for all the imposing array of electronic gadgetry at their disposal, give no evidence whatsoever of being one whit more capable of dealing with the information needed for the command process than were their predecessors a century or even a millennium ago.²²

A review of a few theorists who dealt, to varying degrees, with command and control and information reveals an important commonality. That commonality is the significance of quality information (the medium of a command and control system) in the conduct of battle.

The theorists recognize that an effective command and control system is one that will produce information that is relevant, timely, accurate, in a useable form, and in the right amount. Additionally, Van Creveld explained that the evolution of command and control systems is one of trying to minimize uncertainty and that present day technology falls short of this goal.

Our examination of theorists broadened our understanding of command and control and the role of information. The theorists gave us some insight to the desired attributes of information and the importance of quality information in the decision-making process. To build on our understanding we will next review the current command and control doctrine. This review, like the review of the theorists, will give us a picture of the attributes doctrine requires of information in order to facilitate decision-making.

III. Current Command and Control Doctrine

FM 100-5, Operations, does an excellent job of describing the desired end-state of an effective command and control system in support of AirLand Battle. 'The ultimate measure of command and control effectiveness is whether the force functions more effectively and more quickly than the enemy.'²³

To accomplish the above FM 100-5 calls for a

command and control system which facilitates freedom to operate, allows delegation of authority, and gives the commander the ability to exercise leadership from any point on the battlefield. "The system must be reliable, secure, fast, and durable. It must collect, analyze, and present information rapidly."²⁴

FM 101-5, Staff Organization and Operations, recognizes the variety of tasks that will confront the commander. To allow him to accomplish these tasks a command and control system consisting of three interrelated components is needed. The components are, command and control organizations, command and control process, and command and control facilities.²⁵

The command and control process is the decision-making process and procedures used by the headquarters. Through a defined set of procedures and techniques the command and control process allows the commander and staff to make decisions and accomplish the mission. Military decision-making is both an art and a science and is driven by several factors. The personality, experience, and training of the commander and staff are a few examples. There is, however, a systematic method known as the military decision-making process to aid the commander.²⁶

FM 101-5 gives some specific guidance on using the decision-making process, particularly with regard to

the role of information in the process. It calls for the staff to analyze and condense the information. It also calls for the staff to assess the significance, reliability, and completeness of the information before presentation to the commander. Finally, it warns the staff not to burden the commander with more information than he needs, but to give him enough information to keep him appraised of the situation.²⁷ It is interesting to note that FM 22-103, Leadership and Command at Senior Levels, also gives this sort of guidance for the use of information in decision-making.²⁸

FM 71-3, Armored and Mechanized Infantry Brigade, calls for a responsive command and control system that 'protects the force, motivates the soldier to fight, and eases execution of broad mission orders and tactics.' Like FM 101-5, FM 71-3 describes the command and control system as consisting of three interrelated components: the command and control process, organization, and facilities.²⁹

FM 71-3 defines the brigade command and control process as one of planning, directing, coordinating, and controlling the battle. The process centers around assigning missions and tasks to subordinate and supporting elements to accomplish an assigned mission. Quality information is a mainstay of the process.³⁰

Instruction and student texts used at the Command and General Staff College (CGSC) also offer some good insights on command and control and the decision-making process. ST 100-9, The Command Estimate, recognizes that today's dynamic battlefield requires the commander to make rapid decisions. It also recognizes that the key to the decision-making process is the estimate of the situation. Integral to this estimate is the management of information.³¹

A review of some key command and control doctrine reveals some notable common points. Like the theorists we examined, it is clear that doctrine dictates that quality information is needed if a command and control system is to support effective decision-making.

The theorists and doctrine are in agreement; the command and control system ought to provide information for decision-making and the information should have qualities that match our established criteria. However, what currently occurs in the brigade command and control environment may not match the theory and/or doctrine. This is the subject of our next investigation.

IV. Current Command and Control Environment

Today's command and control environment is driven by AirLand Battle doctrine. It is based on securing

or retaining the initiative and exercising it aggressively to accomplish the mission."³² In order to do this a commander must have rapid and effective communication, as well as quality information. His command and control system must support him in accomplishing this. As discussed in the doctrine section of the study, the brigade commander should have a command and control process that enables him to meet the demands of the modern battlefield.

The current command and control process is common to commanders at all echelons and levels of war. The process consists of four steps: acquire information, assess that information, determine what actions to take, and direct subordinates to carry out those actions."³³ The first two steps of this command and control process definition match the planning element of the FM 71-3 command and control process definition. These two steps, acquire information and assess that information, are the ones we will focus on.

The brigade commander is continually acquiring and assessing information as he fights the current battle and plans for succeeding battles. During the first step of the process, he acquires information about the mission, the enemy, the terrain, his own forces as well as adjacent friendly forces. During the second step of the process he assesses the information in order to

make decisions. Throughout the battle, information acquisition and assessment will be continual. New information, or new assessments of information may cause him to redirect his forces in order to better accomplish his mission.³⁴

Currently, most of the above is a manual process which is laborious and very time consuming.³⁵ An example of this can be seen in the way overlays are handled. They tend to be copied and then carried by courier to the appropriate location. This is done to ensure accuracy, but often at the expense of timeliness.³⁶ Additionally, doing all the above has gotten more complicated, due in part to the commander's decreasing ability to command and control his forces in a direct manner.

This decreased ability to command and control forces in a direct manner is based on historical changes of the battlefield. The specific changes are the following: size and composition of the forces involved in battle, range and lethality of weapons systems, and the physical dimensions of the battlefield.³⁷ All of these factors have combined to degrade the commander's ability to exert direct control over his forces.

Direct control has gotten particularly difficult because of the increased size of the battlefield. This

is true not only of the sheer ground area, but also in terms of the added air dimension of the battlefield. Figure 4-1 is a graphical display of how much acreage an infantry battalion has become responsible for over time as technology has improved weapons and commanders have dispersed forces.

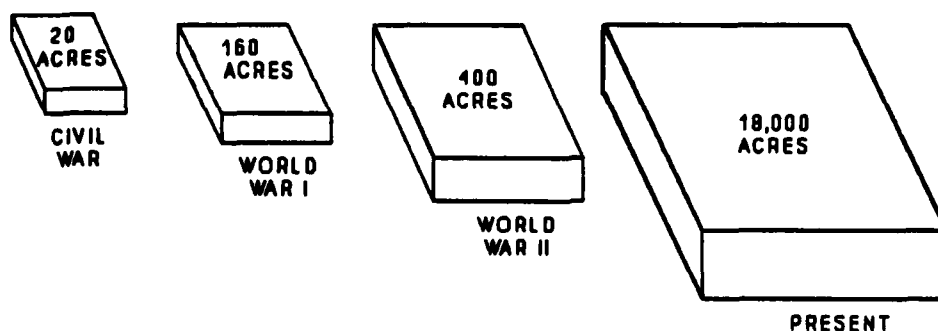


Figure 4-1
Increase in size of a battalion battlefield ³⁸

This expansion of the battlefield caused several things to occur. Moral cohesion, brought about through the close physical proximity of soldiers, decreased. Resultant moral and psychological fragility of the combat troops would not allow the same level of attrition to sustain the intensity of the engagement.³⁹ At the same time, command and control of the battle was also degraded due to the ensuing dispersion.⁴⁰

The dispersal of units, combined with the increased complexity of the force structure, resulted in a decrease in the commander's ability to command and

control his forces effectively. Positive control was replaced with procedural control. Procedural control denotes reliance upon previously arranged procedures or orders. Positive control means the commander can see and influence the entire battle from his command post.⁴¹

Obviously, because of historical changes in the battlefield, particularly the increased size of the battlefield, positive control has become increasingly difficult. Positive control may be more difficult now, but it still involves the commander obtaining information and seeing the battlefield. To do this, he has to get information the best way he can--first hand observation, from his own command post, from subordinate command posts, or from listening to subordinate command nets.⁴² However, because the battlefield has gotten larger and more complex, he requires more information, in order to see the battlefield and make decisions more effectively.

In short, there is a positive relationship between size of the battlefield and the amount of information a brigade commander requires in order to command and control his forces. As the battlefield has increased in size and dimensions, the amount of information a brigade commander requires to make a decision has increased proportionally.

While all this may not be the primary reason for today's brigade command and control system problems, it certainly contributes. Many of these command and control problems have been verified by the following: unit experiences at the National Training Center (NTC), Battle Command Training Program (BCTP), Center for Army Lessons Learned (CALL), and personal experiences of those serving in one of the above organizations.

A central problem identified by observations of units at NTC is "time management and information flow."⁴³ Major William Crain conducted an analysis of NTC unit Take Home Packets (THP) and after action reports to further specify the information and time problems. The effort examined data collected in over 30 rotations beginning with 86-1 through 88-11. Collectively, the documents revealed the problem as "the staff's inability to modify the decision-making process in order to provide critical, timely information; and inadequate or inaccurate information being provided to the commander."⁴⁴ Major Crain's conclusion was that, "the staff must employ a process that produces the critical information necessary to plan and execute timely decisions."⁴⁵

Other examples of information problems in the command and control system are seen in CALL bulletins. Brigadier General E.S. Leland, wrote in a CALL bulletin

that the commander must 'see' the battlefield to control his forces effectively. In order to do this, a 'disciplined flow of information is required and information overload and underload must be avoided.'"

Still other proof regarding information problems that occur in the current command and control system has been found during BCTP exercises. One of the areas routinely found to be a problem for units is management of information. How information should be presented to the commander and the amount and types of information he requires are often difficult areas for a unit to sort through."

Throughout this study we established that a commander requires quality information (i.e. information that is relevant, timely, accurate, in a useable form, and in the right quantity). He needs quality information in order to be an effective decision-maker. It is clear; however, based on the above discussion that the current brigade command and control system does not always provide him quality information.

Effective information management is a method that helps ensure the commander receives the required quality information. Information management is absolutely critical to sound decision-making. "The situation is such that we cannot do the job without the

help of automated information management systems." ⁴⁸

Information technologies (automation) have increased rapidly in the last several years. Automation's role in command and control and information management continues to grow and will likely do so even more in the future. "This technology must be made to serve the commander, to make his job easier or enable him to achieve more with the same effort or resource." ⁴⁹ The potential for improvement at the brigade is tremendous, particularly when you look at the tools currently in use: grease-pencils, hard-copy maps, and bundles of staff papers. ⁵⁰

The ATCCS is designed to take full advantage of technology in the hopes of providing the quality information the brigade commander needs for decision-making and making his job easier. But will it? We will begin to answer this question by first describing the ATCCS.

V. ATCCS Description ⁵¹

The ATCCS is the Echelons Corps and Below (ECB) portion of the Army Command and Control System (ACCS). The diagram at Appendix A, Figure A-1 shows the interfaces and the relationship of ATCCS to the overall ACCS. ATCCS is defined as the aggregate means by which Army Commanders employ and sustain military forces in a

theater of operations. It is composed of organizations (personnel, facilities, equipment, communications, and other material), training (standards, SOPs), and doctrine (processes, organization of staffs and CPs, etc.). The goal of ATCCS is to provide tactical commanders and their staffs the ability to manage effectively as well as use the increasing volume of information generated and required on the modern battlefield.

There are five Battlefield Functional Area (BFA) control systems that comprise the ATCCS. The BFAs and planned systems for each are, maneuver control (Maneuver Control System (MCS)), air defense control (Forward Area Air Defense Command, Control, Communications, and Intelligence System (FAAD C3I)), combat service support control (Combat Service Support Control System (CSSCS)), intelligence and electronic warfare control (All Source Analysis System (ASAS)), and fire support control (Advanced Field Artillery Tactical Data System (AFATDS)). There are three primary communications support systems that will net the ATCCS allowing information to flow continually among and within the BFA control systems. They are, Combat Net Radio (CNR), Army Data Distribution System (ADDS), and Area Common User (ACU) communications. Appendix A, Figure A-2 shows the relationship of the

BFAs and the supporting communications at any given echelon.

The ATCCS is a distributed system whose objective is an interoperable system of subordinate systems that provides commanders at corps and below the means to synchronize forces. Figure B-1, Appendix B is a graphic representation showing the vertical and horizontal dimensions of the objective ATCCS. The ATCCS will also have the capability to link laterally (e.g., between brigades), provided required communications exist. Task organization will determine the total number of BFA nodes. Total number of nodes nears 1,000 in a fully structured corps.⁹² It should be noted that the figure depicts the design goal of ATCCS which is not scheduled for complete fielding as shown until the late 1990's. Currently, the only BFA that extends to the brigade is maneuver control.

Each BFA in the ATCCS is partitioned into three classes of interconnected subsystems as illustrated by Figure B-2 in Appendix B. The subsystems are the following: the force level control system (supports the command aspect of command and control), functional control systems (supports the control aspect of command and control), and subordinate systems.

The Force Level Control System (FLCS) provides automation to support the horizontal synchronization of

the force at a particular echelon (e.g. brigade-level). The function of FLCS is to give the commander and staff the ability to make sound, timely decisions as well as direct the actions of assigned and supporting forces. Specifically, FLCS will perform the following five functions: 1) collect command and control products from the five battlefield functional areas, 2) organize and integrate the information contained in these products, 3) process and present this information to the commander and his staff, 4) support the commander in the preparation of his own command and control products, and 5) make his products available to the rest of the force by way of the battlefield functional area control systems."

The functional control system (one for each BFA) integrates information from the subordinate systems to permit the BFA commander (e.g. Division Artillery Commander) to perform his internal command and control of functional units. The functional control systems support FLCS and the force level commander (e.g. brigade commander) by collecting data and structuring it into meaningful information, disseminating guidance and direction from the force commander and staff, as well as effecting coordination across BFA lines (e.g. DIVARTY to DISCOM).

Subordinate systems are manual or automated

systems which perform unique command and control functions within a BFA. An example of an automated subordinate system within the CSSCS BFA is the Standard Installation Division Personnel System (SIDPERS). Each subordinate system is composed of a set of personnel, procedures, and material that together perform one or more activities of a BFA work-specific or housekeeping function. Information required by a subordinate system to perform its tasks is generated both internally, by the FLCS, other subordinate systems, and the command and control systems of allied nations and other services.

Based on the above discussion, it becomes evident rather quickly that ATCCS is a complicated system when viewed in its entirety. There are, however, some important points to glean from all this in order to begin an analysis of ATCCS and its ability to meet information needs of a brigade commander.

First, there are five BFAs whose design goal is to collect and structure data into meaningful information for the brigade commander. Of these five BFAs, only one, the MCS, currently extends from corps all the way down to brigade (the other four are scheduled to extend to the brigade by the mid-to-late 1990's).

Second, the FLCS is the mechanism by which a brigade commander should be able to command and control

his unit from any of his command posts, from other functional area command posts, or from maneuver command posts at the battalion level. FLCS encompasses command and control functions required by a brigade commander and his staff and it allows for the transfer of information between BFAs.

Lastly, and most importantly, the entire design goal of ATCCS appears geared toward meeting the information needs of a commander on a battlefield having the characteristics as described in the introduction. This point is probably best shown by a portion of the Army Command and Control Master Plan definition of the command and control process.

The key ingredient at all stages of the process is information - timely, accurate, germane and useful information on friendly and enemy forces, and the environment in which they operate. With the wealth of raw data available, especially with the proliferation of ADP systems, information management is absolutely critical to sound decision-making.⁵⁴

It would also appear that if the objective of the ATCCS is met, it will certainly meet the command and control and information requirements as laid out by the theorists and the doctrine we examined. Whether the ATCCS will assist the brigade commander in dealing with significantly increasing information requirements (and provide him quality information), or if ATCCS is merely more "electronic gadgetry,"⁵⁵ will be the focus of the next section.

VI. Analysis and Evaluation

We are at the dawn of the era of the smart machine--an 'information' age that will change forever the way an entire nation works, plays, travels and even thinks. Just as the industrial revolution dramatically expanded the strength of man's muscles and the reach of his hand, so the smart-machine revolution will magnify the power of his brain. But unlike the industrial revolution, which depended on finite resources such as iron and oil, the new information age will be fired by a seemingly limitless resource--the inexhaustible supply of knowledge itself.⁵⁶

Although the above statement was directed toward the civilian world in the early 1980's, its applicability to today's military is appropriate. The evolution of military command and control systems has seen automation efforts, particularly in the command and control arena, being pushed ever toward lower echelons of command. A few years ago most automation was found only at the corps level. Now automation is also found at the brigade, battalion, and even company level. The evolving command and control structure of the Army, in the form of the ATCCS, is pushing all echelons of command into the Information Age, with the brigade commander being a major player.

The brigade commander must maximize all of his resources to achieve the best possible results on the battlefield. Bringing maximum combat power to bear at the decisive time and place is the foundation on which all of his actions must rest. In order to do this, he must manage his resources wisely. Quality information is one of his important resources. The criteria that

make for quality information are, relevancy, timeliness, accuracy, useability, and information in the right amount. The ATCCS is a command and control system that can help the brigade commander manage information. It is not a command and control panacea; however, it is designed to increase the value of information as a resource and aid in decision-making.

The ATCCS will have little to do with the relevancy of information. As is the situation now, relevancy of information for a particular operation will be dependent on the needs and judgment of the brigade commander and his staff. The human element, using the ATCCS as a tool, will be the final arbiter of the relevancy of information.

The sophisticated communications capabilities of the Combat Net Radio, Army Data Distribution System, and Area Common User system give the brigade commander a tremendous opportunity to improve information timeliness. Information will be real-time and linked to the speed of electrons and radio waves, as opposed to the speed of a courier. According to an Israeli general, "the problem is not so much providing information in 'real time', but of getting the real information in time." This is an important distinction."

The FLCS, by software design, will also help in

the timeliness of information. FLCS will give the brigade commander the ability to receive necessary command and control information from any of his command posts, other functional area command posts, or from maneuver command posts. This capability will give him greater flexibility and accessibility to information, thus making the information more timely.

The ATCCS' ability to provide accurate information is potentially afflicted with the automation phenomena of 'garbage-in garbage-out'. It is crucial that those organizations and individuals interacting with the ATCCS recognize the significant burden for accurate information that is placed on them. They must realize that the increased capability to process and transmit information has also increased the possibility of bad decisions being made from inaccurate information.

The above situation is applicable not only for the ATCCS operators and furnishers of information at the brigade level but also of the higher echelons. The ATCCS' ability to process and transmit information rapidly will require that higher echelons closely monitor the information that will be passed to the brigade level. This must be done in order to help avoid bad decisions based on inaccurate information. Higher level staffs will need to act as information filters, not withholding information, but continually

checking on the accuracy of the information they pass.

Providing the brigade commander information in a useable format is one of the greatest potentials of automation and the ATCCS. The capability of automation to produce information in a useable format is often only limited by the imagination of the requester and operator. The ATCCS should be no different.

An example of the ATCCS producing information in a useable format is demonstrated by the MCS. The MCS has a query capability that allows commanders and staffs to retrieve specific information on current friendly force status and their battle resources, information about enemy forces, and information about the operational environment.⁸⁸ Depending on the commander's desires, this information can then be printed using various standard report formats, electronically transmitted to another location, or verbally relayed to the commander.

The FLCS is another example of the ATCCS capability to provide the commander information in a useable form. The commander can get a graphical portrayal of the friendly and enemy situation via the situation report data that is fed into the FLCS from the various functional areas.⁸⁹ Additionally, overlay information can be printed on paper or acetate, or sent electronically to another location.⁹⁰ The commander will be required to guide his staff in providing him

information in the format he desires; however, the ATCCS appears to have the ability to meet the criteria of useability and to meet the personal information format requirements that a brigade commander might have.

The ATCCS capability to provide the brigade commander information in the right amount is not as clear-cut as the other information criteria areas. History shows that furnishing the commander information in the right amounts is important, but not always easy. Even in Napoleon's time, when an overabundance of information was hardly a problem, providing him with 'well-ordered information' in the right amount was one of his staff's most important functions.⁹¹ It would seem that technological advances since Napoleon's time should make providing the commander information in the right amounts easier. This is not necessarily so.

A look at the relationship between technology (of which ATCCS is a subset) and human information assimilation capability reveals some interesting facts. Due to advances in technology, the ability to gather, store, disseminate, and transfer information has increased over time. Determining the exact increase is not the purpose of this study, but suffice to say information technologies have improved over time and could be graphically represented by a positive upward

sloping line.

Humans are more conditioned to receive and assimilate various sensory inputs (e.g. television, stereos, etc.) than previous generations. Additionally, information technologies have incrementally increased individual capabilities to receive and assimilate information. There is however, an optimum amount of information that a human can assimilate before becoming overwhelmed or overloaded. "No matter how capable the individual, his mind can handle only so many decisions in a given time-frame."⁶²

Information overload is becoming a more common occurrence. The reason is due to the increase in number and importance of sophisticated information technologies (i.e., telecommunications systems, microcomputers, and computer terminals).⁶³ This presents an interesting dichotomy. Although our information capabilities, through improved technology, have increased, we may now have access to too much information. The ability to make decisions is "limited simply because so much time is spent going over all the pertinent and peripheral information bearing on every subject within the area of operation."⁶⁴

In an experiment conducted at the Naval Postgraduate School, performance on a simulated

battlefield tended to improve as the overall amount of information about one's opponent increased up to some optimum level. At some point, additional information was too much to be effectively used in the time allotted. Several reasons were offered for this. First, additional information may simply be too much to be assimilated in the time allotted. Another possibility is that the total amount of information is not necessarily excessive but in the format presented appeared excessive."

Psychologists have found that decision performance falls when the number of cues provided to a decision-maker increases beyond approximately ten items of information. This situation is defined as information overload." Information overload has also been defined as information received at such a rapid rate that it cannot be assimilated. Too much information may lead to information saturation. "When saturation occurs, less attention is paid to each additionally received message and thus less information is received."

A graphical representation of the relationship between information technologies and human assimilation is depicted in Appendix C. The graph is not meant to be all encompassing, only to show that there is a relationship between information technologies and

various individual human assimilation capabilities.

There is an area below the intersection of the lines in which the capabilities of information technologies are inadequate and do not supply the brigade commander with enough information for decision. Clearly, there is also an area above the intersection in which information technologies can overwhelm or cast him into an information overload situation. Additionally, individual fluctuations will occur due to factors such as lack of sleep or stress, hence each individual will operate in an area someplace within the box around each intersection.

There are probably several methods for getting the brigade commander to take greater advantage of technology and operate higher up on the information technologies line. While it is not the purpose or within the scope of this study to explore each of these methods, a few thoughts on some of the possible methods will be mentioned.

The more important methods that come to mind are the following: ensuring the staff understands the brigade commander's desires for information, training the brigade commander and his staff to maximize their information technologies, and filtering of information by higher echelons of command.

Ensuring the staff understands the brigade

commander's desires for information is a function of many things. The amount of time that the commander and staff have worked together, the commander's ability to communicate his intent for accomplishing a certain mission, and overall competency of the commander and staff are just a few. Certainly the brigade commander must articulate his information desires to the staff in a manner that will guide them in the processing of enormous amounts of data into meaningful information.

Articulating information needs is an important aspect of commander's guidance to the staff. Preliminary coordinating drafts of FM 101-5⁰⁰, along with special emphasis by the BCTP during warfighter and General Officer Pre-Command Course (GOPCC) sessions highlight this as an essential element for effective decision-making. These information needs are called Commander's Critical Information Requirements (CCIR) and are specific information elements for decision-making. The CCIR are not a set list of items, although it should be noted that many studies have been undertaken to establish a typical set of CCIR.⁰⁰ The CCIR provide a mechanism that the commander can use to guide his staff and command and control system to produce from the vast amounts of raw data that information that will be most useful to him in the decision-making process.

Training the brigade commander to take full advantage of the ATCCS is another method of ensuring he does not operate in an information underload or overload situation. There is a legitimate concern that commanders may get tied to their command and control systems waiting for that last piece of information before making a decision and will subsequently lose the initiative.⁷⁰ However, the commander must not discount the power of technology to help him command better. In a future battle, both opponents will be confronted with handling unsurpassed quantities of information to use for operational planning and intelligence. "The force that can get the information needed the most and use it the best will have an advantage far more critical than numerical superiority of combat forces."⁷¹

The brigade commander must be trained and competent in the effective use of his command and control system. If the automation aspects of the command and control system are overwhelming or if he personally relies on the system too much he will likely be an ineffective commander. He must maximize the available command and control technology and remain in charge. General(R) Donn A. Starry issued a strong warning regarding this situation.

Everywhere we go today, when things go wrong, it's the 'computer' that screwed up. It's the computer--the

technological solution, that didn't accomplish this or that. No human being is responsible for failure anymore. Well now, just who is responsible? Who is in charge--are we or is the technology?⁷²

This is good guidance to commanders at all levels to ensure they do not lose sight of the fact that they are the leaders and are in charge. The command and control automation technologies are tools to be taken advantage of and to assist commanders in the decision-making process.

As the ATCCS is fielded to corps and below, some sort of filtering of information must be established. It will be very easy for higher echelons of command to just "push a button" and dump raw data on the next lower echelon, much of which is probably not needed. Staff officers at every level feel the need to do something. Staff officers will contribute their "glassful to the ocean of informational bilge that soon drowns the unwary commander in his own doubts."⁷³ An effective information management program is in order if we are to prevent lower echelon staffs from having to sift through unneeded data to get their information needs.

Additionally, without an effective information management program, higher echelons of command will continually burden lower echelons with requests for information. Filling these information requirements could seriously hamper a brigade's operation.

particularly when you recognize that a brigade commander and his staff have significantly less time than divisions and corps to plan and execute the battle. A possible irony might be a fighting brigade that, "cannot respond quickly enough to either the enemy threat or the higher command." 74

If methods like the above are not used, the continuing increase in information technologies, specifically the ATCCS, may produce some undesirable results. The brigade commander may find himself surrounded by the best command and control system in the world and unable to capitalize on its capabilities.

In addition to the ATCCS information overload, Martin Van Creveld also warns of a problem that may result from the introduction of high-technology into command and control systems. In his book, Command in War, he reviews the Vietnam War, the command and control systems used, and the entire decision-making process of the Army during that time. His notion of "information pathology" 75 is the result of this review. This notion offers some excellent insight to the type of problems that could be encountered with the complete fielding of the ATCCS. He states that:

...while up-to-date technical means of communication and data processing are absolutely vital to the conduct of modern war in all its forms, they will not in themselves suffice for the creation of a functioning command system, and that they may, if understanding and proper usage are not achieved, constitute part of the disease they are supposed

to cure.⁷⁶

It would seem, if you agree with Van Creveld, that in the quest for certainty we may be in the process of designing and fielding a system that will not aid, but in fact degrade the brigade commander's ability to command his unit.

The above listed problems, or potential problems, that could plague a highly automated command and control system like the ATCCS have not gone unnoticed by the Army research and development community. Through various studies, exercises, and experiments, organizations like the Program Executive Office for Command and Control Systems (PEO - CCS), the U.S. Army Combined Arms Combat Developments Activity (CACDA), the Army Research Institute (ARI), and others are working to ensure some of the above listed problems do not befall the ATCCS.

Research on command and control information requirements generally address one of two objectives. One area of research is directed towards defining the requirements for predominantly automated command and control decision-making systems. The other area of research is directed towards defining the information that should be presented to commanders and their staff to aid them in their command and control decision-making.⁷⁷

Two research efforts that addressed both of the above stated objectives were conducted by the Army Development and Employment Agency, Fort Lewis, as part of a series of experiments in support of the Army Tactical Command and Control System Experimentation

Site (AES). Among other things, both of these efforts were also concerned with information flows, criticality of information, and the effect of automation on the command and control process, specifically at the brigade level.⁷⁸

Another example is a study that was conducted by the MITRE corporation for CACDA. In this research effort the command and control demands of the future battlefield are clearly recognized. A partial summary of the study states the following:

U.S. battlefield commanders and their staffs will be confronted with large volumes of data arising from the rapidly changing environment. They will be faced with the challenge of making sense of this data and acting upon it efficiently and effectively.⁷⁹

The examples given above should suffice to demonstrate that developers of the ATCCS are also concerned with ensuring that the ATCCS meets the information needs of the brigade commander.

Whether the information quality goals for ATCCS will be met or not is yet to be determined. It is clear, however, that technology, of which ATCCS is a subset, has the potential to create an information overload situation and degrade a brigade commander's decision-making capability.

VII. Conclusions

The commander in the year 2000 will enjoy an ability to command and control on a battlefield shrunk to spatial and

temporal dimensions unprecedented in modern times. Born of a generation that has an almost innate familiarity with computers and information systems, it will be his knowledge of C3 [command, control, and communications] systems and his ability to use them to penetrate the "fog of war" that will be one of the primary keys to success on the battlefield of the 21st Century.⁸⁰

Throughout this study we analyzed and evaluated command and control in terms of meeting the information needs of a brigade commander. We reviewed selected theorists and Army command and control doctrine to gain some insight on command and control. We paid particular attention to determining if the theory and doctrine supported the criteria we established for quality information, the medium of a command and control system. Both theory and doctrine address the requirement for information to possess certain qualities. Those qualities (established as criteria) are relevancy, accuracy, timeliness, useability, and information in the right amount.

We looked at the current command and control system used by a brigade commander in helping him to make decisions. The current command and control system, which is mostly manual, is lacking in information quality. Part of the reason for the shortfall was attributed to the increase in size of a battlefield and the parallel increase in amount of information that a commander needs in order to make effective decisions. Commanders and staffs are forced

to deal with increasing amounts of data that must be turned into quality information prior to an effective decision being made. The result of this situation often takes the form of time management and information flow problems. Additionally, information is often untimely, inaccurate, in an unuseable form, or is too much or too little.

We examined the ATCCS to gain a general overview of its current and proposed capabilities. The ATCCS is a complex system when viewed in its entirety. The ATCCS design goals for information match the criteria and are in agreement with theory and doctrine. If the ATCCS meets the design goals (and this will not be fully determined until the ATCCS is completely fielded) then it will make an important contribution towards meeting an important function of command and control automation. This function is laid out by Richard E. Simpkin in his book Human Factors in Mechanized Warfare:

... to remove from the concern of high-grade human efforts the nitty gritty of command - dissemination of intelligence, staff-level coordination, logistics and telecommunications detail. All this can be standardized and automated on a management by exception basis with no loss of effectiveness whatever.⁸¹

Our last focus analyzed and evaluated the ATCCS to determine whether or not it will meet the information needs of a brigade commander. We concentrated on determining whether or not the ATCCS will decrease or

increase the information overload a brigade commander can experience in planning for and executing battles.

The ATCCS, as designed, will have the capability to provide the brigade commander the quality information he must have on the future battlefield. It would appear that the FLCS will be the preferred subsystem for the brigade commander to use, when the ATCCS is fully fielded, in order to provide information to him for effective decision-making. There are, however, some serious cautions that must be observed, particularly if the information pathology Van Creveld describes is to be avoided.

The Army, due to increased information technologies (automation) is in the throes of the Information Age, and is subject to information pathology. The ATCCS is a very automated system that is not immune. The brigade commander and his staff must recognize that the ATCCS will not be a panacea for command and control shortfalls and will only aid in the command and control process. The ATCCS will assist in meeting our information criteria, but there are some concerns. The more important concerns applicable to each criteria are listed below.

Relevancy--the brigade commander and his staff must continue to be the final arbiter of the relevancy of information. Timeliness--the ATCCS will have the

ability to greatly improve timeliness of information; getting the real information in time will continue to be the challenge. Accuracy--accuracy of information will be subject to the 'garbage-in garbage-out' syndrome often afflicting automated systems.

Useability--the ability of the ATCCS to produce information in a useable form will be a function of the imagination of the commander and staff; information can be manipulated and displayed in a myriad of ways, depending on the commander's desires. Information in the right amount--making a determination on the ATCCS' ability to provide information in the right quantity is not as easy to determine as the other information criteria. Information overload, in particular, is something that commanders and staffs at all levels must be concerned with and learn how to avoid.

The ATCCS research and development community, along with organizations like BCTP are also concerned with information overload. Ensuring that staffs understand clearly what information the commander desires is an extremely important step in alleviating the potential information overload problem. If the brigade commander establishes his CCIR, then he will decrease the possibility of an information overload problem.

Command and control doctrine must emphasize the

importance of information as a resource. Like any resource, information, if it is to be effective, must be managed properly. Doctrine must begin to focus on the importance of information management and the pathology of information that can result from highly automated systems. This is particularly true as the ATCCS begins to be fully fielded to lower echelons of command that are faced with making rapid-decisions in order to fight and win on the future battlefield.

Appendix A

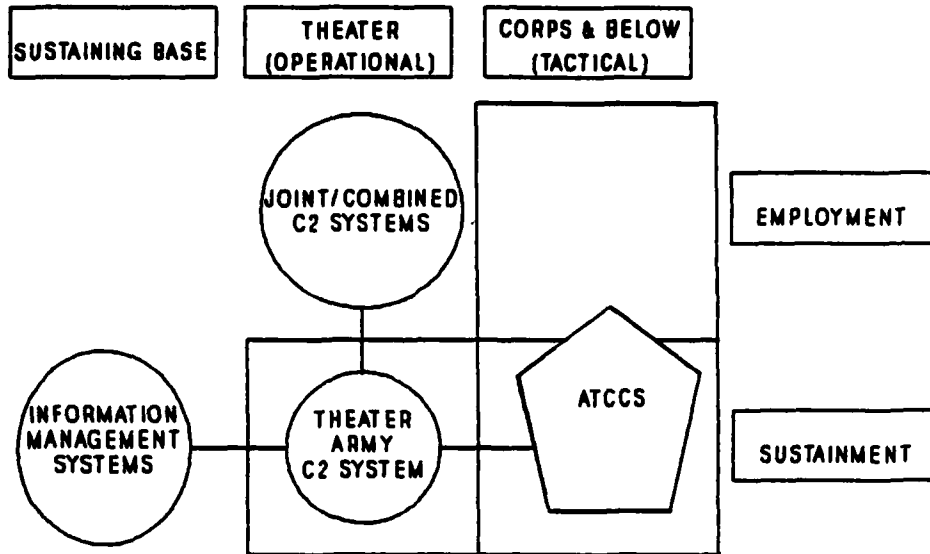


Figure A-1
Army Command and Control System (ACCS)
shows relationship of the ATCCS to the sustaining base
systems and theater (operational) systems⁶²

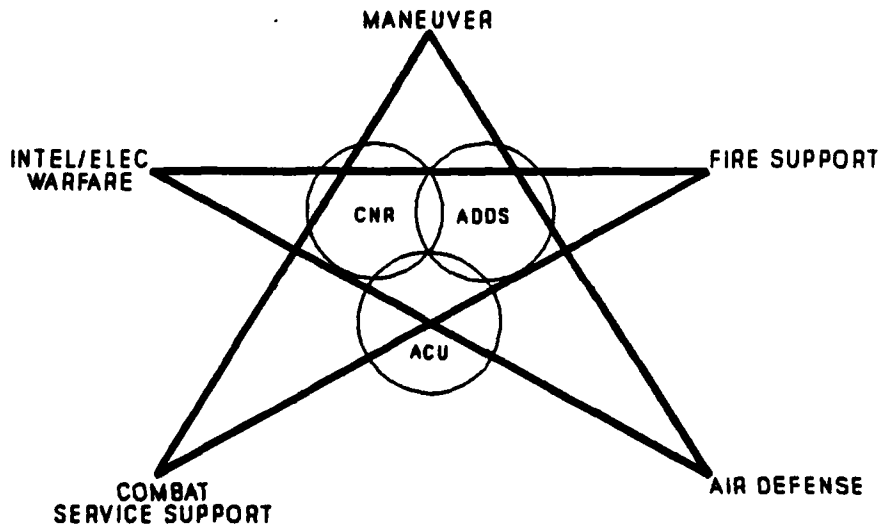


Figure A-2
BFA Relationship/Communications⁶³
Appendix B

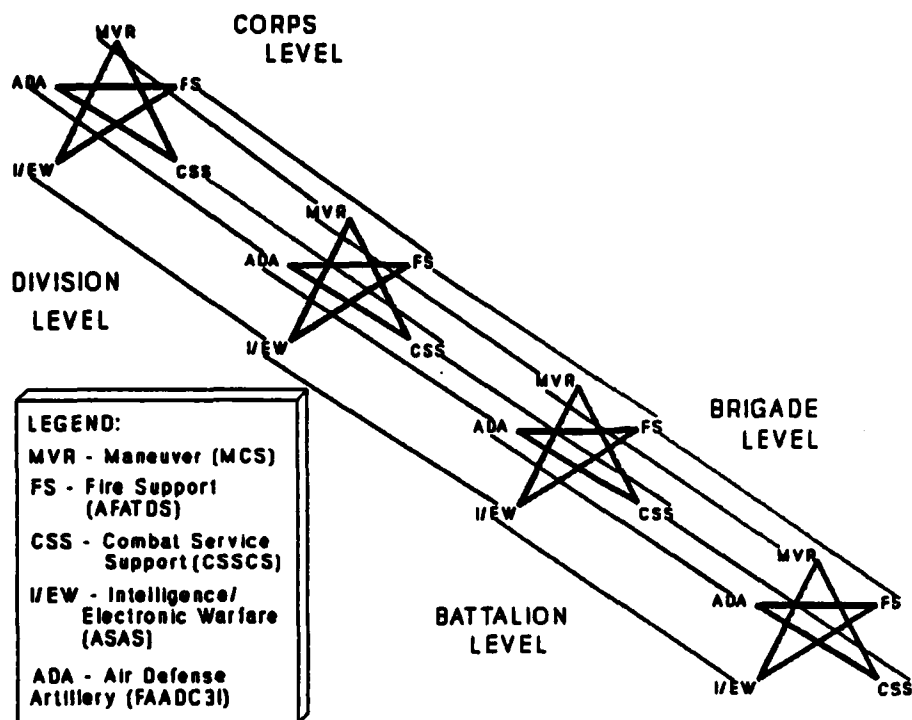


Figure B-1
Horizontal/Vertical Aspect of ATCCS⁸⁴

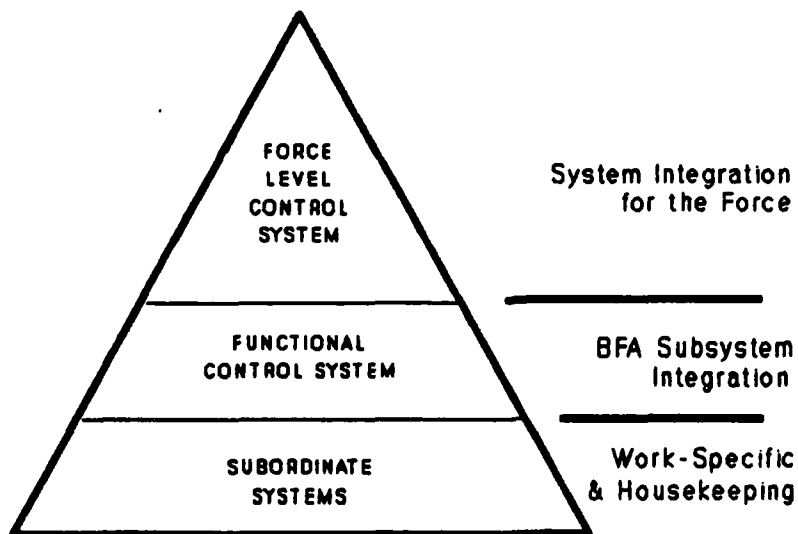


Figure B-2
shows the relationship and subsystems of the ATCCS⁸⁸

Appendix C

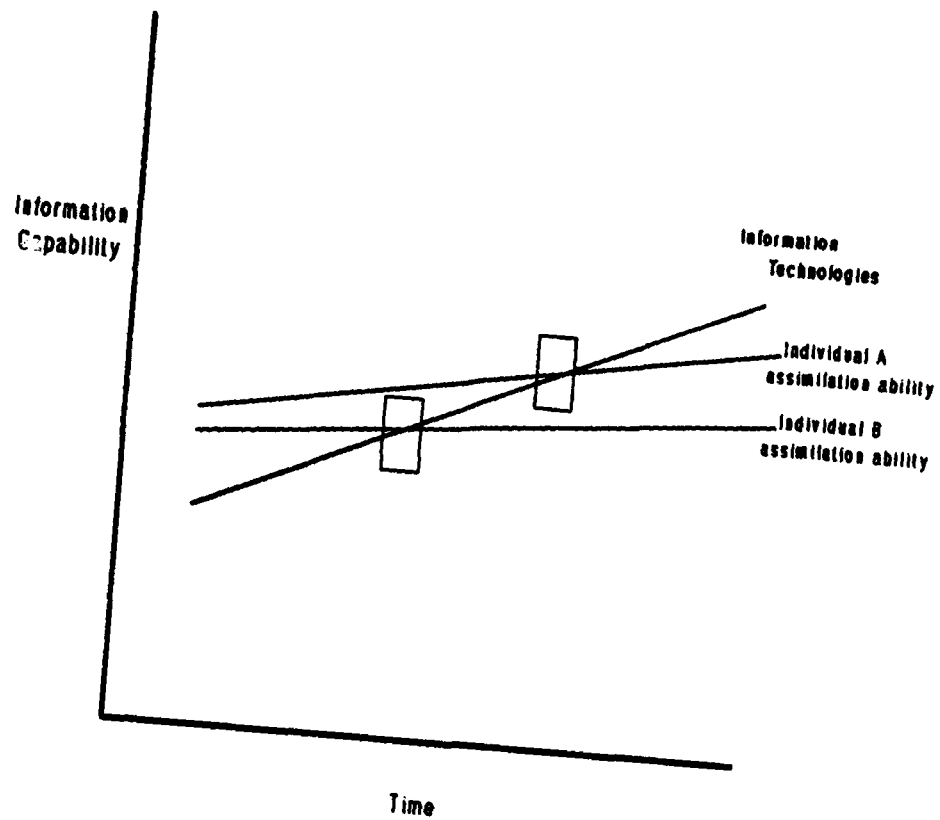


Figure C-1
Relationship between technology and human assimilation ability

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27.Ibid., pp. 4-1 - 4-3.

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29.FM 71-3, Armored and Mechanized Infantry Brigade, (Washington, D.C.: Headquarters, Department of the Army, 1988), pp. 2-1 - 2-2.

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